	Minimum work: $4+"32"e^{-0.2\alpha}=7+16e^{-0.1\alpha}$, $e^{-0.1\alpha}=\frac{2+\sqrt{10}}{8}$, $\alpha=4.3806365...$ 4.38 without the root and an equation will score no marks.	
		(4)
		(Total 12 marks)

Question Number	Scheme	Marks
8	**"In this question you must show all stages of your working. Solutions relying entirely on calculator technology are not acceptable."**	
(a)	$\dfrac{\sec\theta\,\text{cosec}\,\theta}{4\text{cosec}\,4\theta}\left\{=\dfrac{\sin 4\theta}{4\cos\theta\sin\theta}\right\}=\dfrac{2\sin 2\theta\cos 2\theta}{2\sin 2\theta}=\cos 2\theta\,*$ M1: Clearly uses either $\sin 2\theta = 2\sin\theta\cos\theta$ or $\sin 4\theta = 2\sin 2\theta\cos 2\theta$ or equivalent double angle work in the LHS (or RHS) in a correct step with no errors beforehand A1*: Uses both $\sin 2\theta = 2\sin\theta\cos\theta$ and $\sin 4\theta = 2\sin 2\theta\cos 2\theta$ or equivalent work and obtains the given answer with no errors. Only one intermediate stage of working is required by the route above and condone starting with the expression in brackets above. No missing/mixed variables at any stage. Attempts that start on the RHS mark the same way and may start with e.g. $\dfrac{2\sin 2\theta\cos 2\theta}{2\sin 2\theta}$ or $\dfrac{\sin 2\theta\cos 2\theta}{\sin 2\theta}$. Allow meet in the middle proofs. "1=1" proofs need a (minimal) conclusion such as "shown".	**M1** **A1***
		(2)
(b)	$4\left(5\cos^2\theta-9\right)\text{cosec}\,4\theta = 3\left(1+\tan^2 2\theta\right)\sec\theta\,\text{cosec}\,\theta \qquad 0<x<180^\circ$	
	e.g., $\dfrac{5\cos^2\theta-9}{3\left(1+\tan^2 2\theta\right)}=\cos 2\theta$ or $5\cos^2\theta-9=3\left(1+\dfrac{\sin^2 2\theta}{\cos^2 2\theta}\right)\cos 2\theta$ or $5\cos^2\theta-9=3(\sec^2 2\theta)\cos 2\theta$ Correct use of part (a) to achieve $\dfrac{5\cos^2\theta-9}{3\left(1+\tan^2 2\theta\right)}=\cos 2\theta$ or better. Must see a correct equation. Could repeat the work in part (a)	**B1**
	$5\dfrac{(\cos 2\theta+1)}{2}-9=3\sec^2 2\theta\cos 2\theta \Rightarrow 5\cos 2\theta+5-18=\dfrac{6}{\cos 2\theta} \Rightarrow 5\cos^2 2\theta-13\cos 2\theta-6\{=0\}$ M1: Uses both $\cos 2\theta = 2\cos^2\theta-1$ and $1+\tan^2 2\theta=\sec^2 2\theta$ **or sufficient equivalent identities** in their equation and obtains a 3TQ in $\cos 2\theta$. Allow slips in the manipulation but errors with identities can only be sign errors. If they repeat the work in part (a) it must be done correctly. A1: Correct 3TQ. Condone a missing "=0" and recovery including bracketing issues, missing/mixed variables and poor notation but must not be fortuitous. Allow any multiple.	**M1** **A1**
		(3)
(c)	Allow invented non-zero values for *a*, *b* and *c* for the first two marks only. $\left(5\cos 2x+2\right)\left(\cos 2x-3\right)=0 \Rightarrow \left(\cos 2x=\right)-\frac{2}{5}$ Solves their 3TQ in $\cos 2x$ or $\cos 2\theta$ from (b) to obtain $\cos 2x = k$ where $\lvert k\rvert<1$ Usual rules but if calculator used must get one correct root between -1 and 1 for their equation. May have set e.g., $y=\cos 2x$ but do not accept e.g. $x=-0.4$ unless recovered	**M1**
	$\left(\cos 2x=\right)-\dfrac{2}{5}\Rightarrow\{x=\}\ldots$ Obtains any correct 2sf ft value for x in degrees or radians (you may need to check) from their $\cos 2x=\text{"}-\dfrac{2}{5}\text{"}$ $\left\{\text{Note}:-\frac{2}{5}\Rightarrow 0.991\text{ radians (awrt }0.99)\right\}$	**dM1**

	$\{x =\}$ 56.789..., 123.21... $\Rightarrow$ awrt 56.8, awrt 123.2 A1: One of awrt 57 or 123 (may be others in the $0 < x < 180^\circ$ range) A1: Both awrt 56.8 and 123.2 and no others in the range or multiples of 45. No degrees symbol required. Ignore labelling. A marks require a correct 3TQ & correct roots seen. Answers only is 0/4	**A1** **A1**
		(4)
		(Total 9 marks)